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The business model of development of biogas technology market in Poland: opportunities and threats

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ABSTRACT : *Due to the requirements of the EU in increasing the share of energy generated from renewable sources to 15% (3 x 15%) in traditional energy production technology based on fossil fuels combustion in Poland, it is observed a clear trend in the development of renewable energy technologies. Renewable energy market offers a variety of technologies for generation of energy from RES. Scientific evidence indicate that in the near future, a/m sources will be the dominant in energy production. The research is focused on more efficient energy production technologies, cost-effectiveness, minimization energy losses and increase the reliability of the designed engineering systems. The biomass conversion and biogas production is a major source of the "green energy" production in Poland. Planned activities and their application in order to build the biogas plants, despite treatment as the priority goal, at the start implementation phase went through a crisis due to the unstable market causing unprofitable for this type of investment and the possibility of bankruptcy for the newly built installation. Further the analysis of renewable sources of energy in the dominated countries is discussed.*

KEYWORDS: *RES – renewable energy sources, biogas plant, methane fermentation, business model, green energy.*

I. INTRODUCTION

According to experts' predictions there is the potential for the construction of about 2,500 large agricultural biogas plants (with power of 1MW), and several thousands of small with power of a few to several kW, in Poland.

Biomass as one of the major energy carriers
The sustainable management of biomass ensures not only the process of renewability of natural resources, but also gives a chance to produce energy for various purposes. Under Polish conditions biomass is a major source of energy and its obtaining is achieved by:

1. Direct combustion of substrates.
2. Co-firing biomass with fossil fuels.
3. Gasification and energy reuse.
4. Pyrolysis of biomass.
5. Anaerobic digestion.
6. Alcoholic fermentation or esterification (biofuel, biodiesel)
7. Methane fermentation (biogas production).

The national biogas technology market is rich in new installations. There has been built about 40 of biogas power plants so far in Poland. The main idea of modern technology is high performance biogas production in innovative technologic systems to ensure the effectiveness methane fermentation.

II. BIOGAS INSTALLATIONS

The existing biogas installations in the EU have a significant participation in the whole amount electricity production as well as the use of waste heat for various purposes, from renewable sources. In addition, the use of waste as a substrate from agricultural production, food waste, sewage sludge from wastewater treatment plants, the sludge form distillery industry, slaughterhouse material etc. allows for energy recovery from this type of waste and the utilization of hazardous waste in proper way (Dach, 2009). Polish agricultural areas have a significant potential in issue of usage of agricultural waste after production as well as the ability to produce biomass for biogas purposes (Przybył et al. 2011). The composition of biogas from agricultural biogas plants is as follows: 50-70% methane, 29-40% carbon dioxide, hydrogen sulfide, and 0,1-5,5% of less than 1% ammonia. Biogas calorific value is estimated to be between 17-25 MJ/m^3, and depends mainly on the concentration of methane. Due to contamination by other gases, and too low content of methane, it is not possible to directly application of biogas as a fuel for internal combustion engines, i.e. CNG. According to reports, the experts, the most biogas plants are located in China, about 32 million such objects, including a great number of small domestic installations of which biogas is used on-farm.

The most popular technologies applied in Western European be include the NaWaRo systems. The biogas plant technology, included installations and facilities, such as: storage tanks for substrates, bio-digesters to produce biogas, pre-mixing tank, digestive chamber, biogas storage tank, the CHP unit, and the over flow tank. One of the main tasks of the first biogas plant in Germany was the odor deodorization, and after digestive pulpy is characterized by the smell similar to the one as forest litter (Czekała et al. 2012). Methane fermentation process require to maintain proper temperature for the proper operation (37-39 ° C), so in winter in Polish weather conditions, up to 30% of heat should be allocated to heating of bio-fermenter and during the remaining period the heat losses are up to 7%.

The substrate for methane fermentation can be any kind of biomass, and the a/m organic wastes. An important factor is also control a proper C: N ratio, which ensures appropriate biochemical processes and the development of methane bacteria. One of the key economic factors determining the profitability of the investment is to provide a substrate, and its continuous availability and reasonable price. The tests of biogas production efficiency for selected substrates for fermentation, and its technological processing is one of the most important actions in the planning of investments (Dach 2009). Agricultural biogas plants operating proper way should operate an average of 8000 h/year. Politicians basis on of expert guidelines approved a plan to build about 2,500 biogas plants by 2020, in Poland (to the Council of Ministers meeting by the Ministry of Economy in cooperation with the Ministry of Agriculture and Rural Development, 13 July 2010). This document assumes that in every rural commune will be built at list one biogas plant fed by the substrates based on biomass from agricultural sources (Pilarski et al. 2011). Therefore, agricultural biogas plants should be located especially in rural areas, characterized by significant cultivated area of agricultural resources, to obtain a substrate to ensure continuous operation.

The main task of governmental plan was to create favorable conditions for investors who want to build and operate biogas plants for the production and sale of energy. The main sectorial organizations PIGEO, SEO, SNWES and NRI submitted a strategy for the development of agricultural biogas plants in Poland, in order to eliminate barriers to the development and expedite the process of their formation (The innovative Energy - Energy Generation Agriculture). In the opinion of government, the building of biogas plants should preferably improve energy security of Poland by providing a "green energy". With the creation of new biogas plant is expected to be more favorable economic effects i.e.; the creation of employment in areas with high unemployment and a weak industrial structure. Creating this kind local value-added chains will affect the economic activation of rural areas. The positive environmental effects will be manifested in the deodorization odors originating from the storage of manure and slurry, and to obtain a highly efficient fertilizer from post-ferment for second use in agricultural crops (Dach 2009). Properly working biogas plants are characterized by a zero GHG emissions, and should bring CO_2 reduction of 3.4 million tons per year. Assuming that traditionally stored manure is characterized by high CH_4 emissions, the amount of avoided emissions calculated in CO_2eq should be at least several times higher.

The annual production of biogas with achieving goals must be at the level of 7 billion m3, which should cover about 10% of total gas demand, and to provide 125 thousand MWhe of electricity and 200 thousand MWhc of heat. Following the recommendations of the experts "waste heat" also needs to be properly utilized, for example, for industrial purposes, on-farm, or for heating the privet buildings. The various programs and financial instruments provide opportunities for co-financing of construction projects from public funds (including the structural funds combined to public aid) to 50% up of eligible costs. The Ministry of Economy declared the help to constructing biogas plants, which was to be supported under the Operational Program - The Infrastructure and Environment, associated with priority IX environmentally friendly energy infrastructure and energy production efficiency but the measures quickly ran out and they made use of a few private entities. Investors could also take advantage from preferential loans offered by NFOŚ. Very high benefits that investors have seen in the operation of biogas plants resulted from the obtaining of green and yellow certificates for renewable energy production, which can then be sold on the stock exchange of certificates for companies generating the energy in the traditional way by fossil fuel combustion.

Certificates trading take place on the Polish Power Exchange, which receives from the Energy Regulatory Office information about the amount of issued certificates. Compensatory payment for green certificates at the end of May 2012 reached 286.74 PLN/MWh, but in the first quarter of 2013 there was a significant decrease of the prize up to 170 PLN/MWh. For yellow certificates with the decision of the Energy Regulatory Office in 2013, the price remains at about 149 PLN/MWh, which corresponds to 75.06% of the average selling price of electricity in a competitive market. Experts estimated that the biomass in rural areas on Polish territory can cover up to 60% of the total required by UE shares of energy from renewable sources.

III. RESEARCH METHODS APPLIED HERE

The main research problem discussed here is: The analysis of biogas market development in Poland, the assumptions, the real situation and creating a business model.

The applied methods: desk research, benchmarking, experts' panel, SWOT analysis. The development of possible scenarios, took into account changing trends on the Polish market and legal conditions, political issue or social conditions. Panels of experts took place to discuss and establish a ideas for development of investigated biogas technology on polish market at the present time and the forecast tor perspective in 20 years (Nazarko, Ejdys 2011). It also used the elements of brainstorming to generate innovative ideas. It can be considered as a form of improving group decisions by encouraging them to open discussion with elimination of criticism (Nazarko, Ejdys 2011). As a result of information gathering, and a summary of the panel discussion as well as of previous studies conducted by Mazur and Dacha 2012, the possible business model was made for the market of agricultural biogas plants in Poland. Also, the authors determined most likely scenarios for market development in Poland in the period of 20 years.

Transfer of knowledge: Based on earlier research with application of STEEPVL methods (Mazur and Roof 2012), a group of factors was selected that have a significant impact on the development of the of biogas technologies sector in Poland. The SWOT analysis has been carried out in relation to issues closely associated with these factors. A group of factors influencing the development of the biogas plant market in Poland was includes:

1. Social factors: creation of employment, investors tendency to investments in the construction of biogas plants, preparation and education of the public and the local governments to accept this type of investment.
2. Economic factors: The level of co-financing for the construction investments and prize of energy certificates, biogas plant operating costs including the costs of substrate obtaining.
3. Political factors: the issue of energy independence of the country, meeting the expectations of the EU energy policy, professional activation of the rural residents.
4. Technological factors: implementation of technical and technological innovation in effective biogas production, lack of specialists in the field of technology and operation of biogas plants, installations characterized by low odor nuisance.
5. Ecological factors: deodorization of waste and reduction of unpleasant odors, production of energy from renewable sources without CO_2 emissions, the production of agricultural fertilizer from the post-ferment.
6. Values factors: public education, sustainable development, increase environmental awareness.
7. Legal factors: easier legal procedures for waste management, adapting legislation to facilitate investment in the construction of biogas plants, clearly defined scope of the legal requirements for environmental impact assessment (Mazur and Dach 2012).

The SWOT analysis of the expert panel is presented in the table below.

Table 1. SWOT analysis for use of agricultural material such as manure, slurry and other animal and organic waste for high quality fertilizer production in anaerobic technology production:

	Helpful	Harmful
Internal factors	Strengths:	Weaknesses
	The issue of energy independence of the country, meeting the expectations of EU energy policy in the field of renewable energy. High efficiency of resource usage characterized by – productivity and low demand for energy in the process. The total energy production such as electricity and heat, can be used for different purposes. Low GHG emission. A positive environmental effect, by the reduction of emissions from manure stored in traditionally way by its use as a substrate in biogas plants. Long-term supply of biomass ensured, the biomass come from agricultural waste, manure, slurry, energy crops, poultry manure. All of these substrate are continuously	Land use change negative – for maize crops . Unreasonable public opposition to building of biogas plants. Local emissions when technology is improperly operated May have a negative impact on food security or local production of biomass for other applications.

	generated in accordance with the established process of biogas production.	
External factors	Opportunities	Threats
	Impact on biodiversity – neutral Creation of employment, both directly in the biogas plant company, and for external companies, in broad sense of the range of services: such as; formal legal consulting, maintenance, biochemical and others. Medium impact on food security or local production of biomass for other applications. Medium - term economic sustainability.	Failures and wrong operation as a result of negligence of unskilled Staff may have a negative impact on the environment. Lack of specialists in the field of technology and operation of biogas plants, the cause of the faulty operation and the negative impact on the environment and the nearest community.

Source: An own study.

Based on the SWOT analysis and expert panel consultation the business model has been created.

Table 2. Business model base on agricultural activities

Lp.	Feedstock	Conversion	Energy product	Secendary conversion	Secendary energy product	Energy use
1	Biomass corn silage + manure	methane fermentation	Biogas	Electricity cogeneration	Electricity	Used current in network
2	Biomass silage miskantusa + manure					
3	Substrate based on manure + manure			Process Heat	heat	dryers parquet
						Heating of production halls
4	Substrate based on chicken manure + manure					Drying of fruits and seeds
5	Substrate-based agricultural waste + manure					Heating livestock

Source: An own study.

This model takes in consideration the potentials for integrating different actors and processes to produce optimal overall value, and also give good chances for fulfilling the main sustainability criteria. In a panel discussion based on scenarios developed by Mazur and Dach, 2012, experts have validated the possible scenarios and modified them to determine the most realistic forecasts of future of biogas market in Poland.

Regard to the four scenarios proposed by the authors (Mazur and Dach 2012).

SC I – Polish Green Energy El Dorado.
SC II – Energy prodigality.
SC III - Self-Sufficient energy development.

SC IV - Energy and Poland.

As a result of the extreme tendency averaging due to a/m scenarios developed in foresight study, the three new ones were determined to forecasts the development of the proposed business model:

Stable market: conditioning profitability of investments made in the period to 20 years. This scenario provides a dynamic development of biogas plant market in Poland. However, it requires the active involvement of experts and politicians regarding legislative alignment and ensure favorable financial facilities to ensuring a fixed rate of return for the made investment. Experts evaluated the feasibility of this scenario at 10 - 20%.

Market with cyclical variables trends: this is the most likely scenario for 50 - 60%, due to the impasse in politics, the lack of action in adopting legislation and administrative bureaucracy. It will contribute to a significant slowdown in the possible development of the biogas market in Poland. As a result, we achieve only partial results of the required level of energy production from renewable sources. Chance to not bankrupt at unfavorable times, will have investors who have additional capital and only a few can afford to periodic decreases in profitability.

Unstable market - the total legislative impasse and bureaucracy: black scenario of biogas market collapse in Poland, its total lack of profitability. Bankruptcy of potential investors, building biogas plants based on loans. The few functioning biogas plants built by private capital will have a long rate of return under the assumption their own substrate production and the use of waste from other sources such as slaughterhouses, breweries, sewage sludge, etc. The probability of this scenario was estimated to be 10 - 30%.

Based on selected analysis, from the summary of the panel discussion of experts and previous studies conducted by Mazur and Dach 2012, it can be concluded that, despite the good environmental conditions and the availability of biomass substrate for the production of biogas. Soundness of the investment in this type of entrepreneurship is still subject to a high degree of risk due to the unstable Polish market and impasse in the alignment of legislation with regard to the RES. Causes of this situation there are debatable and opinion among the experts are divided. Despite the assumptions in the developed plans and brave declarations invited investors to build a biogas plant and the production of "green energy", the current situation in a negative way verified the worst-case scenario on Polish market of biogas installations. If the deadlock in the implementation of biogas market developing goals, will linger too long it may cause permanent discourage of potential investors and ruin plans to build 2,500 biogas plants until 2020. The fulfillment of a black scenario can have further negative effects resulting from the financial sanctions which the EU will impose on Poland as a result of failure to meet the obligations in the use of renewable energy production in the country. Perhaps the danger financial penalties will be for politicians, forced stimulus for changes in legislation and making it friendly to investment in the biogas market.

II. INDUSTRIAL APPLICATIONS AND TRANSFER OF KNOWLEDGE INTO PRACTICE

The study provides a description how to gain information about trends, opportunities and risks and to evaluate initial situation and further development as well as to identify and evaluate the growth and profit opportunities within the segments of technologies and markets, the industries and value chain. It will deal with the current state of biogas plant market and future developments. It is the study in the biogas business. There are also organized workshops and business conferences in many countries on how to participate in the booming biogas markets worldwide.

Clean energy and renewable energy market – best practices: The world markets for biogas is booming, gets more professional, more high tech on the way to over 80 percent plant efficiency. Today most plants are under 38 percent. "Smart biogas plants" will be "best practice" soon. For this the process control, sensing, instrumentation and automation is an important part with high growth and innovations. A smart biogas plant today is a plant without CO_2 emissions, with solar power, wind power, with various input materials, separate CO_2 and methane, get two gases in high purity and an energy storage at the plant. The cost's by sizes in the study also the explanation of the technology and processes, the very few companies who can do that worldwide. From several companies in 1991 there are now over 700 companies, plant builders and operators worldwide and still growing. But only some companies hold the knowledge for "smart biogas plants" today. The leading countries in Europe are losing their position in this fast-growing market to Asian soon. Other regions develop slow compared to China for example, where the market increases with over 25 percent per year. Also, Germany slows down in there development. Some plant builder is on the way to be a world player, new operators enter the markets and the optimization of today's and older plants is a fast-growing business too. The period of 20 years is a short time in this business so one should

plan and have a strategy to 2030. Here we provide data by year and technology developments to 2030 worldwide. Energy production from biogas worldwide increased last years and will grow faster the next years in Asian, USA and Brazil to name some. Especially plants for the fermentation of household waste, agricultural, industrial and waste water/sludge will demand more plants.

Most countries have or develop regulatory framework for biogas. The market worldwide will reach over 50 billion dollars by 2030 for plant builder, operator and supplier. Furthermore, there is development for the cities and rural areas to have a new source of income, new jobs, new industries and profit. In the future local energy distribution concepts, for electricity, heat, cooling; and fuel biogas will play an important and efficient role.
Biogas can be produced from a wide variety of available organic materials and wastes, including sewage sludge, animal manure, municipal and industrial organic waste, parts from ethanol production, crop residues, and specially grown energy crops and more. This study is research for biogas plants in a few countries with the potentials and developments to 2030, with the markets, technologies and competition worldwide.

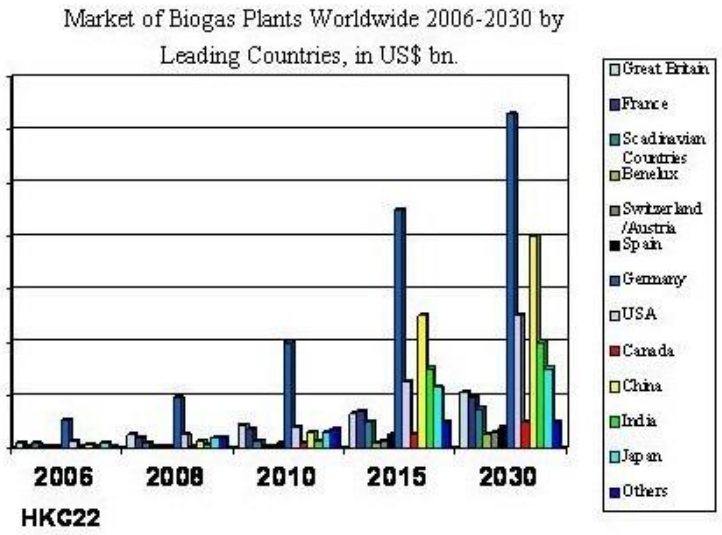

Fig. 1 Biomass market

The world market for water and waste water amounts to 533 Bn dollars in 2011, [12]. The markets are expected to expand further with high growth rates to 674 Bn dollars by 2015.The market figures are for the whole value chain. The regions, technology and consumer segments differ, as well as profit potentials for single markets and companies. 2011 revenue is over 530 billion dollars, with services 60%, equipment 26%, chemicals 2% and others 12%. Plus, Bottled and Bulk Water is over 90 Bn dollars. Water markets are local markets but to be successful as an international company one has to serve and work in most important markets worldwide, over the next 50 years – despite the risks cited here. There is a sharp increase in the demand for efficient irrigation technologies, seawater desalination and sewage treatment facilities, technical equipment (e.g. pumps, compressors and fittings), filter systems and disinfection procedures and new technologies and converging technologies especially in domestic and residential technologies and markets. This water markets worldwide study is most recent and helps to identify the profitable markets and develop a strategy and future plan.

Water market: We completed this paper that researches and valuates the development of the world markets, single consumer sectors and technology segments. The highest growth rates (14% to 2011) are in sectors mineral and bottled water, these markets are expected to double from 2015. In this sector 8 companies are dominating worldwide with a market share of 20%. The global market for table water will show a stable high growth rate, because for the public drinking water there are problems like low quality and in some regions even serious supply shortage. The sales potential for local producers of table water presents more than 12% growth rate in best practice- in comparison. The public drinking water supply has grown with an average annual rate of 9% and high investment in this field is expected. The World Bank has granted an investment of over 450 Bn dollars for the next 10 years. For over one third of the world population in many regions, especially Africa, South America and part of Asia, the drinking water is a quality problem and supply shortage too. There are also such problems even in industrial countries. The water treatment is a segment with an especially high growth rate. The drinking water market worldwide is dominated by communal companies, which belong fully or partially to the states, as well as by big multinational corporations. The sector of supply is dominated by about 20,000 companies worldwide. A

further concentration into big corporations is expected also in the process of privatization due to high investments and operating costs. The drinking water market provides very limited profit potentials (less than 12%), on the other hand it is a long-lasting market with small year fluctuations. Companies and public institutions, that combine drinking water with other utilities like waste water and energy, are fully capable to gain a higher return of more than 15%. The highest growth rates are expected in Asia, especially in China because the state has launched public programs to improve the drinking water situation in the next 5 years. In the field of waste water, i.e. clarification of waste water, the situation has improved slightly. Worldwide, 14% of all waste water in the year 2010 was purified. Bottom of this development are South America and Africa with less than 2% waste water purification. The most important influential factors are population development, increasing demand for foodstuff and thus demand for water, urbanization, germination, pesticides, nitrates and above all resistance to antibiotics in surface water in the industrialized countries.

Clean energy – challenges and expectations in the world: The energy of the future will be and must be regenerative and sustainable. The generation and storage of renewable energy will be the fastest growing sector in energy market for next 20 years. The market volume of renewable energy worldwide will increase from 95.8 billion dollars in 2007 to 124.4 billion dollars in 2010 and reach 198.1 billion dollars in 2015. Today, 15% of the world population consumes more than 70% of the generated energy. However, the fast growth of the developing countries like China and India raises serious question for the balance of energy industry. Meanwhile, the hiking price of oil and gas, the severe air pollution and global warming demand the shift from conventional fossil fuel to clean, regenerative and sustainable energy sources. The major market driving forces come from three aspects. First is the governmental policy and social awareness. In many countries, environmental protection and energy security are the key political concerns which favour the use of clean energy. In most countries governments sponsor programs for using hydropower, wind power and biomass as well as set regulations and standards for emission so that biofuel, solar energy, hydrogen-based energy and other environmental friendly energy are adopted.

Second is the pricing factor. Whereas the oil and gas price is rising in the long term and extremely volatile, the price for renewable energy is stably going downward. The material benefits will naturally attract more and more industrial and residential consumers. Both of these two driving forces are finally based on the development of technology. Only when the technology enables large scale production and competitive costs, is the commercial application possible. Nanotechnology and nano-bio-info converging technologies will be the key enabling technology for renewable energy market during next 20 years. Nanotechnology and converging technologies can modify the molecular structure so that more energy can be stored, transformed and utilised. Their application will largely improve the performance-cost ratio of solar energy, biofuel and fuel cell. These sectors will also experience the fastest growth thanks to technological development. Although fuel cell stores energy rather than produces energy, it plays a major role in the future renewable energy industry. Through minimization, fuel cell can store huge amount of energy within a small volume so that the energy can be easily transported, distributed and utilised in various locations. This will solve the biggest problem of utilising renewable energy, namely the remoteness between energy production and application. Nanotechnology is undoubtedly one of the key technologies to commercializing fuel cell.

Apart from energy production, the saving potentials in the energy market (especially in Europe and North America) are very high. People become more and more aware that energy savings and sustainability in energy generation and energy utilization can be of existential importance. Consequently, the efficient usage of renewable energy is also an important part of the energy industry. As to the regional development, Europe and North America are today's leaders in technology and in market share. Yet, developing countries such as China, India and Brazil are catching up rapidly, or even becoming leaders in certain sector. On the one hand, these countries' industrial boom requires more energy supply; on the other hand, the huge land area and sufficient natural energy resources in these countries provide ideal conditions for utilizing renewable energy. Last but not least, renewable energy will also give easy access to their population in the rural area, where no sophisticated energy infrastructure is present. With the substantial support from government, Asian developing countries will become the fastest growing market of renewable energy in next decade.

Renewable energy markets: Here we present the analysis of the clean and renewable energy markets and developments, research and development, the companies, organizations, branches and products. Here specialists in the market are questioned about their future expectations which are then narrowed through repeated coordination with the specialists. A survey of over 120 enterprises was conducted; the participating companies include flame retardant suppliers, plastic converters and end-use manufacturers in Europe, Asia and America. Information was collected through interview and questionnaire. Information on the business of halogen-free flame

retardants, including economic data on companies and products, were obtained from primary and secondary sources, including government sources, trade associations, companies, and select individuals.

Environmental technologies and markets and sustainable development: Environmental industry depends on the synergy of total Life Science Industries. Environmental industry is a highly technology and innovation related industrial branch. Biotechnology and nanotechnology will play dominating roles in the development of this industry. The vulnerable environment of earth, water, air and energy, as well as the soaring world population demands efficient, safe and cost reasonable technologies to deal with waste, hazardous materials, cleaning and so on. Environmental industry, together with other industries such as food, water, energy, sustainability, is indispensable for the constitution of a high-quality living space in the 21st Century. The world markets for sustainable technologies will attain 5 trillion dollars by 2020 from 1.6 trillion today. This includes environmental technologies and renewable energies with 1.2 trillion dollar in 2020 from today 616 billion. The highest growth rates are in China with over 15% per year from a low level today. The growth of efficiency is between 0.5 and 2% per year depending on the country. Europe accounts for 20% and US for 15% with low growth rates and Asia account for 12% with high growth rates. Increasing water and health problems from scarcity, pollution and contamination are the key driving factors for the markets worldwide beside of the climate change and energy prices.

The development of the environmental industry depends largely on the total development of the Life Science industries. Environment affects directly the health of people and the production of food. A society with advanced medical technology and food industry has big concern for environmental protection. The private spending and governmental investment will proportionally increase. Meantime the innovation and industrial basis in other Life Science industries will facilitate the development of environmental industry. The second stage is additive technology, in which single biotechnical or nanotechnical innovation is applied to improve the performance. This stage serves as a bridge for the transformation from the traditional industry to the new NBNI (nano-bio-neural-info) based industry and has already taken 11.6% of the market volume; it means 74.6 bn dollars in 2003. The NBNI based industry uses integrated new technologies on the molecular scale, which significantly promote the efficiency of dissolving the waste, eliminating the toxicoidand restoring the environment. A handful of companies have already entered this stage, but the market is only 15 bn. dollars in 2003. The ideal of environmental technology is zero-emission. All the waste will be sorted and transformed into useful materials in the recycling plants. Some experiments of specific branches have been taken in different countries, for example the total water management center. Nevertheless, the market is just at the start.

Asia has by far the largest growth rate in the worldwide environmental industry, especially in the “end of pipe” stage. The reasons are: firstly, the industrialization of China, India and Southeast Asia causes immense environmental problems. Merely China has seven cities ranked as the most polluted cities in the world; secondly, there is astonishing insufficiency of the basic environmental protection infrastructures. The potential is mammoth; further, the governments vow to improve the deteriorated environment, especially in China, where 2008 Olympics and 2010 Expo were held; last but not least, the labour cost there is low and suitable for the development of the low-tech but high-labour „end of pipe“stage.

In other continents, Europe will lead in the technology development. The strong environmental consciousness and limited territory will stimulate European countries to adopt the most up-to-date innovations. USA will be a close competitor because of their gigantic industry scale and advanced Life Science technologies and nanotechnologies. Environmental industries are closely related with waste water industry, regenerative energy and clean energy industries. They will also be included in the statistics of the environmental market as a whole; their detailed analysis could be found.

III. CONCLUSIONS

European Commission requires form all Member States to increase the share of energy generated from renewable sources. The process observed as difficult and not easy to implement into practice. Some good world examples were presented in comparison with Europe. The main country is China and other Asian countries which make research that is focused on more efficient energy production technologies.

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